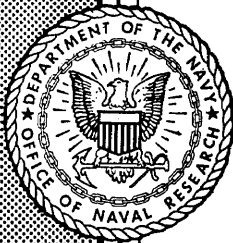


U.S. NAVY RADAR SYSTEMS SURVEY



NAVAL RESEARCH LABORATORY

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U.S. NAVY RADAR SYSTEMS SURVEY

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September 27, 1949

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NAVAL RESEARCH LABORATORY

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ABSTRACT

A series of studies reviewing naval electronic systems was initiated in order to facilitate the prosecution of problems related to the integration of systems for "Command" purposes. This report enumerates all current and proposed Navy radar systems, itemizing approximately 25 operational and technical characteristics. A bar graph showing frequency relationships of these radars is also included.

PROBLEM STATUS

This is an interim report on one phase of the problem; work is continuing.

AUTHORIZATION

NRL Problem R07-25R
NR 507-250

U. S. NAVY RADAR SYSTEMS SURVEY

PREFACE

This survey is one in a series of studies to facilitate the prosecution of Part II* of NRL Problem 39R07-25R. Not only those systems presently installed but also all systems proposals under consideration and all developments in progress are included in the survey, thereby providing characteristics of surface, sub-surface, airborne, amphibious, mobile, and landbased equipments. Only by this means was it possible to assure consideration of all available equipments and techniques.

Initially it was necessary to establish a subject classification by means of which the many kinds of electronic equipments could be grouped. A review of library systems including Dewey Decimal, filing systems, the subject breakdown used by the RDB committee on Electronics, and others did not disclose any classification readily adaptable to electronic equipment. Appendix A shows the breakdown which has been developed for use with the project. Admittedly, the classification of a number of equipments under certain fields is controversial, but this listing was prepared principally as a means of organizing electronics into compartments of manageable size, and of permitting like systems to be grouped together.

Radar was selected as the first major field to be reviewed. For purposes of this survey, Radar is defined to cover search and weapon control radars, indicators, and trainers. Other closely related subjects will be treated under their respective fields as shown in Appendix A. For example, radars which are employed in landing systems will be surveyed under the field of Navigation.

Excellent cooperation and courtesy were encountered in contacts with personnel in the various material bureaus of the Navy Department. A large amount of data which was entirely adequate for this project was obtained directly from charts that had been previously prepared by these bureaus. The presentation of data was reviewed by the activities which supplied the respective information so that the charts contained in this survey should be accurate as of April 1949.

Appendix B lists 15 sources of information that are referred to numerically on each chart, and in addition shows examples of NRL problem assignments and RDB project cards. Appendix C is a bar graph showing the disposition of Navy radars in the frequency

**Part II of this problem was identified in paragraph 6 of NRL Letter Report 3950-18/49 (3954) Ser., 6981 dtd May 10, 1949, to ONR, "Electronics; Combat Command Electronic Systems, Problem 39R07-25R; Interim report on; forwarding of," (Secret).*

spectrum. Radars are grouped on the graph according to their use, and those having a common frequency coverage are combined and so indicated.

Although every effort has been made to assure accurate and complete data, the authors invite any corrections or additions of new material the reader may be able to provide.

* * *

TABLES
SURVEY OF NAVY RADAR SYSTEMS

SHIPBOARD SEARCH RADARS

Peak Power Output (KW)	Pulse Length (μ sec)	Frequency (Mc)	Pulse Rate (PPS)	Smallest Ship	Function
85	0.5	8740 - 8890	600	SS	Attack
500	1 4	1244 - 1350	600 150	SS	Air search
500 250	5.5 0.4	1244 - 1350 6275 - 6575	300 1800	DE	Air Surface
10MW	7	1215 - 1350	220	CLC	Air
200	1/3 2/3	9080 - 9375	3000 1500	DD	Hemispherical
200	0.37 1.3	5450 - 5825	650	DD	Surface Zenith search
200	0.37	6275 - 6575	683	PT	Surface
500	1 4	1250 - 1350	600 150	CV	Air
500	1 4	1250 - 1350	600 150	CL	Air
500	1 4	1250 - 1350	600 150	DD	Air
40	0.17	34550 - 35050	750	PC	Surface
700 to 2000	1 2	3430 - 3570	1000 500	DD	Height finder
1MW 250	0.5 0.25 1.5	3600 (Tent) 34550 - 35050	2000 600	DD	Surface
200	0.25 1.3	6275 - 6575	615	PC	Surface
10MW	7	1244 - 1350	300	CL	Air

Maximum Reliable Range (Miles)		Scan Coverage		Scan Rate RPM		Beam Widths	
2200T DD	20 M ² Aircraft B/S = .5	Hor.	Vert.	Hor.	Vert.	Hor.	Vert.
10	--	360°	16°	60°/sec	--	2°	16°
20	70	360°	12°	0 - 12	--	3.5°	12°
20 15	50 --	360°	30° --	7½ - 15	--	5.5° 3°	30° 12°
--	300 alt. to 15 miles	360°	20°	10	--	1.5°	2.4°
20	20	360°	80°	5 - 15	0-10-30 per sec	2.9°	2.5° 1.7°
20 miles 0	20 15	360°	14°+ 12° CSC ² θ 50°	5 - 15	--	2° 2.2°	14°+ 12° CSC ² θ 50°
15	15	360°	90°	15	manual	2.5°	14°+ 12° CSC ² θ
20	70	360°	10°	5 - 15	--	3.2°	10°
20	60	360°	20°	5 - 15	--	3.2°	20°
20	50	360°	30°	5 - 15	--	3.2°	30°
10	--	360°	10°	0.6 6.0	--	0.6°	10°
20	45	30° 200°	36°	1/2/3 5/10	0/5/10 20/sec	3.5°	1.1°
20 20	35 --	360°	14°+ 12° CSC ² θ 20°	1-15-15	--	1.75° 0.17°	14°+ 12° CSC ² θ 2°
20	20	360°	14°+ 12° CSC ² θ	15	--	1.3°	14°+ 12° CSC ² θ
20	200	360°	20°	15	--	2°	4°

Main Lobe DB Gain	Minor Lobe DB Down	Reflector		Ant. Weight (lbs)	Total System Weight (lbs)	90 Knot Wind Load (lbs)	Range Resolution
		Type	Size (ft)				
26	24	LINEAR	.5 x 3	300	5000	--	--
27.9	22	PARABOLOID	5 x 15	1500	--	--	--
-- --	22 --	PARABOLA	12 x 4 1 x 4	860 TOTAL	-- 3000	-- --	-- --
35	28	PARABOLOID	35' W 21' H	12 TONS	--	--	--
37	20	PAR- CYL	12 x 2½	2000	6300	1400	± 100 YDS
30 23	25 20	SECTION PARABOLA	2'x7' 55"x58"	630	--	700	± 100 YDS
28	25	SECTION PARABOLA	1½ x 5	125	1200	250	--
28.8	21	SECTION PARABOLA	5 x 18	750	--	1100	--
27.3	22	SECTION PARABOLA	6 x 17½	750	--	1450	--
27	26	SECTION PARABOLA	6 x 17½	750	--	1500	--
35	30	SECTION PARABOLA	8"x60"	125	1000	150	--
37	17	SECTION PARABOLA	15 x 5	3000	5 T	1500	--
33 50	30 35	SECTION PARABOLA LENS OR PARABOLA	4 x 12 3 x 12	500	--	--	--
33	27	SECTION PARABOLA	2 x 9	225	1600	--	--
32	28	SECTION PARABOLA	25 x 13	7 TONS	--	--	--

STABILIZATION				POWER SOURCE			
TYPE	ACCURACY	ROLL LIMIT	PITCH LIMIT	PHASE	FREQ.	VOLTS	KVA
--	--	--	--	1	60	115	3.8
--	--	--	--	1	60	115	5
STABLE BASE	$\pm 2^\circ$	30°	10°	1 1	60 60	115 115	10.5 10.5
STABLE BASE	$\pm \frac{1}{3}^\circ$	25°	8°	3	60	440	130
STABLE BASE	$\pm \frac{1}{3}^\circ$	25°	8°	3	60	440	20
--	--	--	--	1	60	440 220 or 115	4.0
--	--	--	--	1	60	115	2.25
--	--	--	--	1	60	115	5
--	--	--	--	1	60	115	5
--	--	--	--	1	60	115	5
--	--	--	--	1	60	115	1.7
STABLE BASE	$\pm \frac{1}{3}$	30°	6°	3	60	440	20
STABLE BASE	± 15 MIN	$\pm 45^\circ$	$\pm 8^\circ$	1	60	115	--
--	--	--	--	--	--	--	--
STABLE BASE	$\pm \frac{1}{3}^\circ$	30°	8°	3	60	440	40

TRANSMISSION LINE				REFERENCES	No. in Use or Tent. Available Date
Type	Number	Size (inches)	1 Way db/FT Loss		
Guide	RG-51/U	5/8" x 1 1/4"	.044	2 NE 090201	FY 53
Guide	RG-69/U	3/4 x 6 1/2	.0025	2	FY 53
Guide	CAY 14 ACM	6 1/2 x 3 1/4	.0228	NE 050402	FY 52
Guide	RG-50/U	1 1/2 x 3/4	.0228	6 and 2	
Wave Guide	RG-103/U	6 1/2 x 3 1/4	.0022	NE 050513, 15 R02-22R 6 and 2	FY 55
Wave Guide	RG-51/U	1 1/4 x 5/8	.044	NE 050403 R02-23R 6 and 2	FY 51
Guide	RG-49/U	1 x 2	.02	NE 050412 2	FY 52
Guide	RG-50/U	3/4 x 1 1/2	.0228	NE 050609 2	FY 51
Guide	CAY 14 ACM	6 1/2 x 3 1/4	.00251	2	FY 49
Guide	CAY 14 ACM	6 1/2 x 3 1/4	.00251	2	FY 49
Guide	CAY 14 ACM	6 1/2 x 3 1/4	.00251	2	FY 49
Guide	--	Tent. 1" circular	.02	NE 050613 2	FY 51
Guide	RG-75/U	1 1/2 x 3	.0075	NE 050407 2	FY 52
Guide Guide	RG-48/U --	1 1/2 x 3 Tent. 1" round	.00875	NE 050614	FY 53
				NE 050618 2	FY 51
Guide	RG-103/U	6 1/2 x 3 1/4	.0022	NE 050516, 27 R02-55R 6	FY 55

	SEC. CLASS.	REMARKS	MODEL
	C	Short Exposure Submarine Attack Radar	AN/BPS-1
	C	VK-2 Indicator Known Also As XDU Radar Similar to ST Except for Frequency	AN/BPS-2
	C	AN/SPA-4 Indicator	AN/SPS-1
	C	Multiple Vertical Beams and Multiple Indicators. Replaces XDQ	AN/SPS-2
	C	10" VK-2, 12" VL, 20" VN 2 Transmitters S-1430 is Intermediate Range Version NRL R02-42R	AN/SPS-3
	C	VJ Repeaters; 5" 'A' STD Remotes Sur- face and Zenith Search Antennas on Same Pedestal. Similar to SG-6 Except for Frequency	AN/SPS-4
	C	7" PPI; 5" PPI Auxiliary Bridge Repeater	AN/SPS-5
	C	12" VJ or 12" VK STD Remotes MTI under Development	AN/SPS-6
	C	12" VJ or 12" VK STD Remotes	AN/SPS-6A
	C	12" VJ or 12" VK STD Remotes	AN/SPS-6B
	C	Adapted to Navigation in Ice Packs. Uses 10" SPA-4 as System Indicator. STD Remotes	AN/SPS-7
	C	300°-200° Sector Scan at 2-5 RPM. VK-2, VL Modification of SX (Lightweight) Replacement for SP	AN/SPS-8
	C	Simultaneous Operation of Both 3600 & 5000 MC Systems on 2-12" PPI's. "Rubber" Range Scales of 0.5, 1.0, 4, 20 & 80 miles. Antennas on same Pedestal	AN/SPS-9
	C	AN/SPS-10 is 115 VAC. AN/SPS-10X is 115 D.C. Equipment. VJ or AN/SPA-4 Repeater used as Master Indicator. STD Remotes	AN/SPS-10 AN/SPS-10X
	C	Standard Remote Indicators For Guided Missile Detection	AN/SPS-11

SHIPBOARD SEARCH RADARS

Peak Power Output (KW)	Pulse Length (μ sec.)	Frequency (Mc)	Pulse Rate (PPS)	Smallest Ship	Function
500	$\frac{1}{4}$	1250 - 1350	$\frac{600}{150}$	CV	Air
500	$\frac{1}{4}$	1250 - 1350	$\frac{600}{150}$	CL	Air
500	$\frac{1}{4}$	1250 - 1350	$\frac{600}{150}$	DD	Air
23	0.17	23744 - 24244	750	LSM	Surface
200	$\frac{0.37}{1.3}$	6275 - 6575	650	DD	Surface Zenith
200	5	$\frac{195}{215}$ - $\frac{205}{225}$	60	DD	Air search
400	$\frac{1/3}{1.25}$	3550 - 3700	750	CVE	Traffic control CCA
50	2.	3019 - 3100	$\frac{750}{800}$ 850	DD	Surface
400	$\frac{1/3}{1.25}$	3550 - 3700	750	CL	Surface
200	5	215 - 220	60	CL	Air search
20	1	9000 - 9160	400	PT	Surface
50	1	9000 - 9160	400	PC	Surface
200	0.37	6275 - 6575	400	PT	Surface
200	$\frac{0.37}{1.3}$	6275 - 6575	650	PC	Surface
700	$\frac{1}{5}$	2785 - 2820	$\frac{600}{120}$	DDR	Height finder

Maximum Reliable Range (Miles)		Scan Coverage		Scan Rate RPM		Beam Widths	
2200T DD	20 M ² Aircraft B/S = .5	Hor.	Vert.	Hor.	Vert.	Hor.	Vert.
20	80	360°	10°	5-15	--	3.2°	10°
20	70	360°	20°	5-15	--	3.2°	20°
20	60	360°	30°	5-15	--	3.2°	30°
8	--	360°	10°	0.6 6.0	--	.8°	10°
15 0	15 12	360° 360°	14° + 12° 12° CSC 2θ 50°	5-15 5-15	--	2.5° 2.2°	14° + 12° 12° CSC 2θ 50°
8	50	360°	60°	4	--	22°	60°
20	25	360°	12°	15-30	.05-.25	2.5°	2°
15	10	360°	15°	4-8-16	--	5°	15°
20	20	360°	10°	2.5-5	--	2.6°	10°
12	60	360°	20°	4	--	20°	20°
9	--	360°	9°	9	--	3.2°	9°
10	--	360°	13°	5	--	1.5°	13°
12	--	360°	17° + 15° 15° CSC 2θ	15	--	2.7°	17° + 15° 15° CSC 2θ
13	--	360°	17° + 15° 15° CSC 2θ	15	--	2.7°	17° + 15° 15° CSC 2θ
20	35	360°	30°	0-6	MANUAL	3°	3°

Main Lobe DB Gain	Minor Lobe DB Down	Reflector		Ant. Weight (lbs)	Total System Weight (lbs)	90 Knot Wind Load (lbs)	Range Resolution
		Type	Size (ft)				
28.8	21	SECTION PARABOLA	5 x 18	850	---	1100	--
27.3	22	SECTION PARABOLA	6x17 $\frac{1}{2}$	850	--	1500	--
27	26	SECTION PARABOLA	6x17 $\frac{1}{2}$	850	--	1500	--
34	30	SECTION PARABOLA	8"x60"	305	--	450	--
28 23	25 20	SECTION PARABOLA	1 $\frac{1}{2}$ x 5 50"x53"	600 600	--	600 600	--
13.5	18.4	MATTRESS 12 DIPOLE	4 x 15	600	2425	1200	---
35	30	SECTION PARABOLA	12x10	1100	--	--	--
23	19	SECTION PARABOLA	1 $\frac{1}{2}$ x4	340	2120	330	---
27.5	24	SECTION PARABOLA	1 $\frac{2}{3}$ x7 $\frac{1}{2}$	425	3970 4205	425	--
19.5	18	MATTRESS 36 DIPOLE	17x17	2400	4600	2000	--
30	26	SECTION PARABOLA	6"x26"	125	875	136	--
32	25	SECTION PARABOLA	5"x48"	160	1561	237	--
27	25	SECTION PARABOLA	1 x 4	175	881	200	--
27	25	SECTION PARABOLA	1 x 4	195	1870	250	--
32	20	PARABOLA	8' DISH	2700	6235	900	--

STABILIZATION				POWER SOURCE			
TYPE	ACCURACY	ROLL LIMIT	PITCH LIMIT	PHASE	FREQ.	VOLTS	KVA
--	--	--	--	1	60	115	5.5
--	--	--	--	1	60	115	5.5
--	--	--	--	1	60	115	5.5
--	--	--	--	1	60	115	.8
--	--	--	--	1	60	440 220 115	4
--	--	--	--	1	60	115	3.5
STABLE BASE	± 20 MIN	$\pm 15^\circ$	$\pm 4^\circ$	1 3	60	440	5
--	--	--	--	1	60	440 220 115	3
STABLE BASE	--	--	--	1	60	440-220 or 115	4
--	--	--	--	1	60	115	4.75
--	--	--	--	DC	DC	26	1.7
--	--	--	--	DC	DC	115	2.8
--	--	--	--	DC	DC	26	2.1
--	--	--	--	1 DC	60 DC	115 115	2.5 3.0
3 AXIS	± 25 MIN	30°	10°	1 3	60 or DC	220 or 440AC 115 or 230DC	15

TRANSMISSION LINE				REFERENCES	NO. IN USE OR TENT. AVAILABLE DATE
Type	Number	Size (inches)	1 Way db/Ft Loss		
Guide	CAY 14 ACM	$6\frac{1}{2} \times 3\frac{1}{4}$	.00251	2	--
Guide	CAY 14 ACM	$6\frac{1}{2} \times 3\frac{1}{4}$	.00251	2	--
Guide	CAY 14 ACM	$6\frac{1}{2} \times 3\frac{1}{4}$	.00251	2	--
Not Required		--	--	2	--
Guide	RG-50/U	$1\frac{1}{2} \times 3\frac{1}{4}$	.0228	2	48
Coax	RG-18/U	0.945"	.013	1 and 2	41
Guide	RG-48/U	$1\frac{1}{2} \times 3$	.00875	2	
Guide	RG-48/U	$1\frac{1}{2} \times 3$	.00875	NE 050413 1 and 2	300
Guide	RG-48/U	$1\frac{1}{2} \times 3$	.00875	1 and 2	6
Coax	GAS	1 5/8	.00003	1 and 2	2
Guide	RG-51/U	$5/8 \times 1\frac{1}{4}$	.044	1 and 2	
Guide	RG-51/U	$5/8 \times 1\frac{1}{4}$	.044	1 and 2	50
Guide	RG-50/U	$1\frac{1}{2} \times 3/4$	.0228	1 and 2	
Guide	RG-50/U	$1\frac{1}{2} \times 3/4$	.0228	1 and 2	3
Guide	RG-48/U	$1\frac{1}{2} \times 3$	.00875	NE 050504 1 and 2	8(SP-2s) FY 50 111(SP's)

SHIPBOARD
SEARCH
RADARS

	SEC. CLASS.	REMARKS	MODEL
	R	12" VJ or 12" VK STD Remotes	AN/SPS-12
	R	12" VJ or 12" VK STD Remotes	AN/SPS-12A
	R	12" VJ or 12" VK STD Remotes	AN/SPS-12B
	C	5" PPI. Antenna Transmitter-Receiver is one Unit	CXJG (CINDY)
	R	VJ Repeater; 5" A; STD. Remotes; Surface and Zenith Search Antennas on same Pedestal	SG-6
	U	12" PPI. 5" A STD Remotes A.V.C	SC-5
	R	CCA uses VK as System Indicator. STD Remotes	AN/SPN-6 SG-7
	U	5" A 7" PPI Console STD Remotes	SG-1B
	R	5" A 7" PPI Console STD Remotes	SG-3
	U	12" PPI 5" A STD Remotes	SK-1
	R	5" PPI	SO-3
	R	5" PPI	SO-4
	R	5" PPI Plus 5" PPI Auxiliary Bridge Repeater	SO-5
	R	5" PPI SO-6 IS 115V DC SO-10 IS 115V AC	SO-6,10
	R	5" A/R, 7" PPI, 3" Tracking, Large Console See AN/SPQ-2 SP-2 in Mod. SP by Field Charge 23	SP SP-2

SHIPBOARD SEARCH RADARS

Peak Power Output (KW)	Pulse Length (μ sec.)	Frequency (Mc)	Pulse Rate (PPS)	Smallest Ship	Function
300	4	192 - 198 215 - 225	120	DD	Air search
350	1 4	550 - 660	180 600	CL	Air search
500	1 4	1244 - 1350	150 600	CL	Air search
500	1 4	1244 - 1350	600 150	CL	Air
500	2	1244 - 1350	300	DD	Air
500	2	1244 - 1350	300	DD CL	Air search
85	0.5	8740 - 8890	600	SS	Surface Torpedo F.C.
85	0.5	8740 - 8890	600	SS	Range only
50	0.5 1	9000 - 9160	600	DE	Surface
50	0.25 1	9000 - 9160	600	DE	Surface
500	1	3400 - 3650	400	SS	Air search
500	1	3400 - 3650	400	SS	Height finder
600	1	3400 - 3650	400	SS	Air search
500	1	3400 - 3650	400	SS	G/m track
700 1000	1	3500 - 3550 2780 - 2900	1170 390		Height finder Early warning

Maximum Reliable Range (Miles)		Scan Coverage		Scan Rate RPM		Beam Widths	
2200T DD	20M ² Aircraft B/S = .5	Hor.	Vert.	Hor.	Vert.	Hor.	Vert.
8	50	360°	50°	7	--	22°	50°
8	55	360°	22°	7	--	7.5°	22°
20 20	30 70	360°	38° 10°	5 5-15	-- --	4° 3.2°	38° 10°
20	60	360°	20°	5-15	--	3.2°	20°
20	50	360°	30°	5-15	--	3.2°	30°
20 20	25 70	360° 360°	30° 10°	5-15 5-15	-- --	8° 3.2°	30° 10°
12	--	360°	16°	0-8	--	2.6°	16°
10	--	360°	12°	HAND	--	25°	12°
15	--	360°	3.8°	6	--	3.8°	3.8°
20	--	360°	3.8°	6	--	1.9°	3.8°
15	25	360°	60°	0-6	--	5.5°	60°
--	35 LOON	360°	-10° to +80°	0-6	20°/SEC	5°	2.3°
15	30°	360°	60°	0-6	--	5.5°	60°
15	85 BEACON	360°	5°	0-6	--	2.3°	5°
20 20	40 60	360 360	11 18	0-4 0-4	10°/SEC --	3.5° 1.6°	1.1° 18°

Main Lobe DB Gain	Minor Lobe DB Down	Reflector		Ant. Weight (lbs)	Total System Weight (lbs)	90 Knot Wind Load (lbs)	
		Type	Size (ft)				
15	18	MATRESS	6 x 15	711	2678	1400	--
22	30	SECTION PARABOLA	6 x 15	790	4771	1700	--
23 28.8	-- 21	LINEAR SECTION PARABOLA	1½x17 5 x 18	750 750	4317	1600 1100	--
27.3	22	SECTION PARABOLA	6 x 17½	750	--	1450	--
27.0	26	SECTION PARABOLA	6 x 17½	750	--	1500	--
21 28.8	-- 21	LINEAR SECTION PARABOLA	1½ x 9 5 x 18	375 750	2283	425 1100	--
26	21	SECTION PARABOLA	8"x30"	200	6200	--	--
14	16	PERISCOPE WINDOW	6"x3"	--	844	--	--
33	25	FULL PARABOLA	2' DIA	210	1275 1900	150	--
36	28	SECTION PARABOLA	2 x 4½	180	2500	200	--
23.5	26	SECTION PARABOLA	2 x 4	370	3400	--	--
33°	24	SECTION PARABOLA	8 x 3	3000	--	--	--
23.5	26	PARABOLOID	2 x 4	370	5000	--	--
33	24	SECTION PARABOLA	3 x 8	1000	--	--	--
37 34	17 20	PARABOLA PARABOLOID	15 x 5 5 x 14	6400 6400	22000 --	4000 4000	-- --

STABILIZATION				POWER SOURCE			
TYPE	ACCURACY	ROLL LIMIT	PITCH LIMIT	PHASE	FREQ.	VOLTS	KVA
--	--	--	--	1	60	115	7.5
--	--	--	--	1	60	115	7.0
--	--	--	--	1 1	60 60	115 115	5.0 5.0
--	--	--	--	1	60	115	5.0
--	--	--	--	1	60	115	5.0
--	--	--	--	1 1	60 60	115 115	5.0 5.0
--	--	--	--	1	60	115	3.8
--	--	--	--	1	60	115	3.8
2 AXIS	$\pm 2.5^\circ$	$\pm 45^\circ$	$\pm 7^\circ$	1 DC	60 60	115 115	2.3 4
2 AXIS	$\pm 1.0^\circ$	$\pm 30^\circ$	$\pm 5^\circ$	1	60	115	3.5
--	--	--	--	1	60	115	6
2 AXIS	$\pm 2.5^\circ$	$\pm 25^\circ$	$\pm 10^\circ$	1	60	115	6
--	--	--	--	1	60	115	6
--	--	--	--	1	60	115	6
3 AXIS 3 AXIS	± 30 MIN ± 30 MIN	15° 15°	5° 5°	3 33	60 60	440 440	37.5 37.5

Type	TRANSMISSION LINE		1 Way db/ft loss	REFERENCES	NO. IN USE OR TENT. AVAILABLE DATE
	Number	Size (inches)			
Coax	RG-20/U	1.195	.011	1 and 2	97
Coax	Gas	1 5/8	.00004	1 and 2	
Guide	RG-69/U	3 1/4 x 6 1/2	.00251	RO2-47T 1, 2, 12	18 (SR-3)
Guide	CAY 14 ACM	6 1/2 x 3 1/4	.00251	2	
Guide	CAY 14 ACM	6 1/2 x 3 1/4	.00251	2	
Guide	CAY 14 ACM	6 1/2 x 3 1/4	.00251	1 and 2	
Guide	RG-51/U	5/8 x 1 1/4	.044	1 and 2	70
Guide	RG-51/U	5/8 x 1 1/4	.044	1 and 2	30
Guide	RG-51/U	5/8 x 1 1/4	.044	1 and 2	250
Guide	RG-51/U	5/8 x 1 1/4	.044	RO2-49T 2, 12	
Guide	RG-48/U	1 1/2 x 3	.00875	1, 2, 12	17
Guide	RG-48/U	1 1/2 x 3	.00875	NE 050502 2	FY 50
Guide	RG-48/U	1 1/2 x 3	.00875	NE 050507 2	FY 51
Guide	RG-48/U	1 1/2 x 3	.00875	NE 050518 2	1
Guide	RG-48/U	1 1/2 x 3	.00875	RO2-48T 2	18

	SEC. CLASS.	REMARKS	MODEL
	U	7" PPI, 5" A STD Remotes SRA is Field Modified SR using Plate Modulation was XBF	SR-A
	R	7" PPI, 5" A STD Remotes	SR-2
	R	5" STD Remote $B = .5(2F6F-10,000 \text{ ft}-30 \text{ miles})$ SR-3A is SR-3 with SPS-6 Antenna	SR-3 SR-3A
	R	SR-3 with SPS-6A Antenna. 5" A STD Remotes	SR-3B
	R	SR-6 with SPS-6B Antenna 5" A STD Remotes	SR-6B
	R	5" A STD Remotes SR-6A is SR-6 with SPS-6 Antenna	SR-6 SR-6A
	R	5" PPI 3" A/B Console	SS-1
	R	SS-1 Console & SS Transmitter XDU is K Band Model ST-1 and ST part of SS	ST-1
	U	5" A, 5" PPI, SU is 115V A.C. SU-1 is 115V D.C.	SU/SU-1
	R	5" A 5" PPI STD Remotes	SU-2
	R	5" PPI 3" A/B Console (CXLJ-Triple Antenna Development for Radar TFF and RCM)	SV-1
	C	VF and SS Indicator; Amplidyne Train and Elevation Control	SV-2
	C	VK, 3" A Hydrogen Thyatron Modulator on Basic SV-1 2 12" PPI's	SV-3
	C	Sector Scan and Large Antenna on SV-1	SV-4
	R	Console, 7" RHI, 7" PPI, 7" MSS, or STD Remotes $B = 5$ (F80-18000 ft - 50 miles) (F4U - 25000 ft - 55 miles)	SX

LANDBASED SEARCH RADARS

PEAK POWER (KW)	PULSE LENGTH (μ sec)	PULSE RATE (pps)	FREQUENCY RANGE (Mc)	FUNCTION
200	1.3 .37	650	6275 - 6575	Height Finder
600	4.	200	1220 - 1280	General Search
750	4.0	220	1220 - 1350	-
600	4.	200	1220 - 1350	General Search
-	1.0	400	2770 - 2830 2992 - 3019	Surface Surface and Air
50	1.	465	9000 - 9160	Height Finder
750	5. 1.	120 600	2787 - 2818	Mortar Locator
750	0.5	1000 per beam	2800 - 3000	Long Range Air
-	-	-	1215 - 1350	Air Search & Tracking
285	0.8	731	2905 - 2845	Air Search
200	5	60	215-220	Microwave E.W.
750	1.0	350	2800	Surface search
50	2.0	775, 800, 825	3000	Height Finder(EW)
700 1000	1.0	1170, 390	3500 - 3550 2780 - 2900	Weather Tracking
50	1.0	650	3300	Cielometer
	0.365	700, 900	X Band	Surface and Air

Max. Reliable Range (miles)		SCAN COVERAGE		SCAN RATE (RPM)	
2200 T DD	20 n ² Aircraft B/S = .5	HOR	VERT	HOR	VERT
--	65	360°	-5° to +25°	6	1 to 1½ scan/sec
Horizon limited	100	360°	No Scan	15	--
--	100	360°	--	0 - 15	--
--	100	360°	--	0 - 15	--
35	--	360°	--	--	--
35	--	360°	2 or 6°	6	--
--	80	360°	0 to 30	0 to 6	--
--	--	3°	5°	--	--
--	200	360°	0 to 20°	15°	--
--	--	360°	-70 to +1580 Mils	6	Manual Tracking
12	60	360°	20°	0 - 5	
15	35	360°		4, 8, 12.	
20	40	360°	11°		
20	60	360°	18°	0 - 4	10°/ sec.
		360°	-20° to 20°	12 or 24	

BEAM WIDTH		MAIN LOBE DB GAIN	MINOR LOBE DB GAIN	REFLECTOR	
HOR	VERT			TYPE	SIZE (ft)
4°	.8°	36.5	Coma lobe 9 db	Section Parabola	3 X 15
3°	11°	--	--	Paraboloid	4 X 15
3°	11°	--	--	Paraboloid	4 X 15
3°	11°	--	--	Paraboloid	4 X 15
--	--	--	--	Paraboloid	3 X 5
1.5°	2 or 6°	36.9	--	Slotted Section Parabola	3 X 5
3°	3°	34	12	Parabola	8
--	--	--	--	--	--
--	--	--	--	--	--
3°	3°	34	--	Dish	8
20°	20°	19.5	18		
5.6°	15°			Slatted Parabola	15 x 48 inches
3.5° 1.6°	11° 18°	37 34	17 20	Paraboloid	
9°	9°				

TOTAL SYSTEM WEIGHT	RANGE RESOLUTION	TRANSMISSION LINE			
		TYPE	NUMBER	SIZE (in.)	1 WAY db/FT LOSS
5 T	--	WAVE GUIDE	UG/50	--	--
5760	--	COAX.	--	1 - 5/8"	--
2600	--	COAX.	--	1 - 5/8"	--
--	--	COAX.	--	1 - 5/8"	--
3212 Less Trailer	--	--	--	--	--
2590 Less Trailer	±100 yds	WAVE GUIDE	--	1½" x 1"	--
58,391	--	WAVE GUIDE	--	1½" x 3"	--
--	--	--	--	--	--
--	--	--	--	--	--
--	±150	COAX.	--	7/8"	--
4600					
3000	± 400	WAVE GUIDE		1½ x 3	
350					

POWER SOURCE				REFERENCES (misc.)
PHASES	FREQ. CYCLES	K.V.A.	VOLTS	
1 or 3	60	4	115	NE 050505, 24
1	400	2.8 .45	115 27 D.C.	NE 051003 R95-97T #1
1	400	2.8 .45	115 27 D.C.	NE 050508
1	400	2.8 .45	115 27 D.C.	#1
--	--	4	--	#1
1	60	4	115	NE 051102 #1
1 or 3	60	15	115	NE 050506 #1
--	--	--	--	NE 051204
--	--	--	--	NE 050408
3	60	12	115	RO7-27T
1	60	4.75	115	1, 2.
3	60	50 kw	120/208	Code 945
1	60	3	110/440	Code 945
				Code 945
1	400 - 2400	541 w 782 w	26 dc 115	Code 945
				Code 945
				Code 945

LANDBASED
SEARCH
RADARS

Remarks	Sec. Class.	MODEL
Uses VK-2 for PPI. Has R.H.I. and "A" Indicators. 7 in use.	C	AN/MPS-4
39 in use.	R	AN/TPS-1B
To replace AN/TPS-1B, MTI, PPI, and "A" Scopes.	C	AN/TPS-1D
Transportable 1B with miniature techniques.	C	AN/UPS-1
PPI	U	SO-7M/N
PPI, MTI Indicators.	R	SO-12M/N
"A", "R" Scopes PPI Electrical Hoist on Antenna. 2 in use.	R	SP-1M
To locate high trajectory projectiles and their source. Uses 6 stationary beams amphibious.	C	AN/KPQ-1
To detect targets moving up to 700 MPH. Provide multibeam scan every 4 sec. Height indication by signal comparison.	S	—
Modified SCR 584. For detection and tracking of close support aircraft. Helicalscan.	C	AN/MPQ-2A
	U	SK - 1M
5 in use.	R	AN/CPS-1
40 in use.	U	SG -2S
4 in use.	C	SX - 1
20 in use.	U	AN/APS-2
	U	AN/GMQ-2
	R	MK - 33

AIRBORNE SEARCH AND WEAPON CONTROL RADARS

PEAK POWER (KW)	PULSE LENGTH (μ sec)	FREQUENCY RANGE (MC)	PULSE RATE (PPS)	FUNCTION
.025	1.0		700	
avg.	0.5	9335 - 9415	1400	Surface
40	.6	9375 \pm 55	600*	Air and
(mean)	2.1(B)	9310 \pm 10(B)	1000	Surface
.04	1.0		1000	Search and
avg.	0.5	9375 \pm 40	2000	Intercept
.005				Surface and
avg.	.8	9345 - 9405	800	Navigation
40	1.0, 0.5,	9375 \pm 55	622, 1155,	360° Look-
(mean)	2.0(B)	9310 \pm 10(B)	1347, 350(B)	ing Recon.
	1.5, 0.5	9375 \pm 55	640, 2000,	Search Inter-
40	0.25, 2.1(B)	9310 \pm 10(B)	4000, 450(B)	cept G.A.
1000	2	2880 \pm 30	300	A.E.W.
2000	2	2880 \pm 30	300	A.E.W.
250	25, 1.5,		600, 2000,	Lock Follow
	2.35(B)	9375 \pm 40	300(B)	Intercept
250	1.6	9375 \pm 40	1260	Spherical
	4.5, 0.5,	9375 \pm 55	200, 800,	F.L. Recon.
70	2.25(B)	9310 \pm 10(B)	400(B)	Radar
	4.5, 0.5,	9375 \pm 55	200, 800,	360° Look-
70	2.25(B)	9310 \pm 10(B)	400(B)	ing Recon.
		9375 \pm 55		
		5280 \pm 30		Air
	.75, 5.0,	375 \pm 55	200, 800,	Transport
40	2.25(B)	310 \pm 10(B)	300(B)	Search
		9375 \pm 55		Anti
1000	-	5280 \pm 30	300	Snorkeling
	4, 1.75,	9375 \pm 40	2500, 550,	
250	2.25	9310 \pm 10(B)	360(SNB)	Air
				Tail
40	.5	9245 \pm 30	2000	Warning
				Gun
40	.4	9245 \pm 30	2500	Laying

AIRCRAFT INSTALLATION	MAX. REL. RANGE 20M ² AIRCRAFT B/S = .5	MIN. RANGE (MILES)	MAX. ALT. (Ft)	SCAN COVERAGE	
				HOR.	VERT.
				160°	2°
SB 2G-4E, 5.TBM- 3E. AD-1.2, AM-1		250	30000	150°	31° to -33° 13 to -37°
PB4Y-2 K- Airship	15	250	35000	360°	+21° to -32°
F4U-5N, AD-3N, 4Q, 4N, 4	2-4	150	40000	1300 30°(G.A)	15° to 20°
TMB-3W, PB-1W AD-3W, 4W		2000	30000	360°	
ZPN		2000	30000	360°	8° Beam Dep. 2° down
F4D, F10F, F7U, F3H	15	150	50000	170°	±45°
Escort Version of X02J	10	500	50000	Complete sphere	
PBM-5, 5A, AF2S, P2V-4 UF-1, AJ-1		200	40000	150°(A) 6°(B)	View 20° CSC ² +18° to -55
P2V-1, 2, 3, ZP2K		200	40000	360°(A) 60°(B)	View 27° CSC ²
				180°	
R5C, D JRM, R4D, R4Q-1		150	50000	360°, 240° 120°	±15° pencil CSC ² 3°-40°
P2V-4		200	40000	360°	Modified CSC ²
Jet Night Fighter	150 Map 15 (INT)	150	50000	170° 30°	+90°
F3D	3	150	50000	180°	180°
F3D	4000 yds	150	50000	120° cone	120° cone

RANGE ACCURACY	AZIMUTH ACCURACY	MAX. TRACK RATE		SCAN IN.	
		RANGE	ANGULAR	SEARCH	TRACK
±5%	±3° over center 50° ±50 over remainder				
±1-7%	±3%				
±2%	±3% A.I. to search				
±10% range	±1/2° G.A.			Wigway	Spiral
±2%	±1.5°				
±2%	±1.5°				
±25 yds. track	±2.5°	900 K	45° /sec	Wigway Stop	Conical
±5%	±5°			Spiral	
±3%	±2°				
±3%	±2°				
±2%					
±3%	±0.5°				
±2%	±3°			Wigway	Stop Wigway
±2%	±3°			Spiral	
±25 yds	±.25°	900 K	45° sec	Conical	Conical

SCAN RATES		BEAM WIDTHS		REFLECTOR	
RPM	Looks per min.	Hor.	Vert.	Type	Size
35					
	30-50 55-70	24°-41° 100° (S)		Paraboloid	14"
--	--	--	--	--	--
--	--	--	--	--	--
For 15 12-24, 10%	For 15A,B 12 or 24	--	15°	Paraboloid	29"
60	60	--	--	Paraboloid	18"
6-10	6 and 10	--	8° depressed 20° down	Paraboloid	3'x8'
6-10	6 and 10	--	8° depressed 20° down	Paraboloid	3'x8'
--	--	--	--	Paraboloid	30"
--	15	--	--	Paraboloid	20"
--	50-20 (A) 100-55 (B)	--	10° to -20°	Modified Paraboloid	18"
24 4-7(A)	100-50 (B)	--	CSC ²	Modified Paraboloid	29"
--	--	--	--	--	--
40-15	50-18 90-35	--	--	Paraboloid CSC ²	18" 30"
--	3, 6, 12	--	--	Modified Paraboloid	3'x8'
--	60 45	--	--	Paraboloid	30"
--	1200	--	--	Paraboloid	12.5"
--	1800	--	--	Paraboloid	10"

POWER SOURCE				TOTAL SYSTEM WEIGHT	NO. IN USE OR AVAIL. DATE
PHASE OR AMPS	FREQ. (CPS)	KVA	VOLTS		
		.07	26 dc		
	800-2400	.76	115		
3 amps		.084 kw	28 dc		
1	800-2400	.69	115	185	15,000
		.81	27 dc		
	800-2400	.78	115	242	
		.125	27 dc		
	380-1600	.385	115	123	10
20 amps	400-2400	950 w	28 dc		
			115	399	
2.5 amps	380-1760		28 dc		
(19-A)	800-2400	650 w	115	169	Fall 1000
27A, 1,	400-800	2750 w	28 dc		
1	380-420	220 w	120/208	1275	1950 for
			120		P2V-4
40 amps	400-800	6.5 kva	29 DC		
3	400	300 w	115/208	1350	JAN
			115		1952
60 amps			20 DC		
3	320-1000	2000 w	115	400	Oct
					1952
200 amps					
3	320-1000	4 kw	115	750	Dec.
					1952
20 amps			27 dc		
9 amps	380-160		115	380	1948 - PBM-5
					1950 - P2V-4
20 amps			27 dc		
9A, 1 phase	380-1600		115	400	250
				1400	
11 amps			28 dc		
1	300-480	1.6	150	250	JAN
					1950
			28 dc		
3	320-1000		115/208	1500	Oct.
					1951
		1.7 kw	28 dc		
60 amps	380-420	1.5 kw	115	Total	127
			28 dc		
15 amps	380-420	.5 kw	115	weight	127
			28 dc		
10 amps	380-420	1.5 kw	115	650 lbs.	127

INDICATORS		SEC. CLASS.	DISPLAY		REFERENCES
PPI	OTHERS		IFF	BEACON	
		U			No. 11
	Two 3" (B) double dot	U			No. 11 and EL-80
		U			No. 6 and 11
		U			No. 11
5" 5" Rep.	2" (A)	U			No. 6, 11 and EL-80
	3" B(S), 3" O(I) 3" V (G.A.)	R	yes	yes	EL-80
3-5"	1-3" (A)	R			No. 6 and 11, R02-05, 06, 10, 16D
3", 5", 7" 7" special		C			EL-80 and NL414008
	5" Band C	C	yes	yes	No. 6, EL-80 and NL402007
2-7"	2-5" (C)	C	yes	no	EL-80 NL 402008
2-5" Sector		R			No. 11 and EL-80
2-5"		R			No. 11 and EL-80
		C			NL406023
2-5" 1-5" NAV.		U			NL404027
5" 7" & 10"	3" (A) 2-7" Book	C			EL-80
5"	5" (C)	C	yes	yes	EL-80 NL402006
	3" (O)	C	no	no	EL-80 and 6
3" Modified U with meter for range presentation		C	no	no	EL-80

AIRBORNE
SEARCH
AND
WEAPON-
CONTROL
RADARS

REMARKS	MODEL
Rectangular Scan. Obsolescent.	AN/APS-3
*PRS 1000 for 4-20 50-mile ranges and 600 for 100-mile ranges. A forward looking carrier based air search for bomb rack mounting.	AN/APS-4
Obsolescent. Spiral scan covers a conical volume of 120°.	AN/APS-6, 6A
For evaluation.	AN/APS-10
Heavy patrol aircraft.	AN/APS-15, 15A, 15B
Replaces APS-4, 6. For all carrier based aircraft nightfighters.	AN/APS-19, 19A
Also used as ASW Radar.	AN/APS-20, 20A
Carrier and patrol LTA.	AN/APS-20B
Includes computer for 20 MM Guns, rockets, and bombs. (Glide bombing) Tentative characteristics. Computer similar to a FCS Mk 11.	AN/APS-25
Not intended for surface search.	AN/APS-29
Forward search only. For carrier based aircraft.	AN/APS-31
For medium patrol aircraft.	AN/APS-33
MTI and G.P.I.	AN/APS-41
Transport radar	AN/APS-42
	AN/APS-44
Long Range, high power search intercept gun	AN/APS-21
aiming and tail warning for two place fighters.	AN/APS-28
Includes computer for 20 MM. Special computer for AN/APG-26.	AN/APG-26

AIRBORNE SEARCH AND WEAPON CONTROL RADARS

PEAK POWER (KW)	PULSE LENGTH (μ S)	FREQUENCY RANGE (MC)	PULSE RATE (PPS)	FUNCTION
--	--	--	--	AEW Beacon
6	2.5, 5, 5.0 (B)	975 \pm 55 940 \pm 3(B)	200, 400, 800, 1600(B)	Search and Bomb
7.5	0.4	9350-9400	1600	Automatic Range
30-50W avg.	--	10000-10250	--	A.R.O.
50 W, cw	--	X Band FM	--	A.G.L.
50	--	X Band	--	A.G.L.
50	--	X Band	--	A.G.L.
50	--	X Band	--	A.G.L.
5-10	.4 \pm .1	9375 \pm 40	800 \pm 25	A.R.O.
112	--	2700-2900	576	Mid-Course Guidance
--	--	X Band	--	Bomb Release
--	--	X Band	--	Height Finder
--	--	--	--	AEW
--	--	3000	--	Air and Zenith Watch
--	--	--	--	AEW
250	--	X Band	--	Tracking and Beam Rider
--	--	VLF	--	Surface
--	--	--	--	Surface

[illegible]

RANGE ACCURACY	AZIMUTH ACCURACY	MAX. TRACK RATE		SCAN IN:	
		RANGE	ANGULAR	SEARCH	TRACK
--	--	--	--	--	--
$\pm 2\%$	$\pm 1.25^\circ$	--	--	--	--
± 25 yds.	--	900K	--	--	--
± 10 yds. or 3%	--	900K Closing 300K Opening	--	--	--
± 15 yds.	4 Mils or less	1200K	$140^\circ/\text{sec}$	Stop Wigwag	Simul. Lobe
± 15 yds.	4 Mils or less	1200K	$75^\circ/\text{sec}$	--	Mono. Pulse
± 15 yds.	4 Mils or less	1200K	$140^\circ/\text{sec}$	--	Conical
± 15 yds.	4 Mils or less	1200K	$140^\circ/\text{sec}$	Wigwag Conical	Conical
± 25 yds.	--	1000K	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

SCAN RATES		BEAM WIDTHS		REFLECTOR	
RPM	LOOKS PER MINUTE	HOR	VERT	TYPE	SIZE
--	--	--	--	--	--
--	(S)-60 (T)-600	--	--	Paraboloid	36"
--	--	--	--	Horn	5" dia.
--	--	--	--	Horn	5" dia.
--	--	--	--	--	2 - 11" dia.
--	--	--	--	--	2 - 12" x 6"
--	--	--	--	--	11"
--	--	--	--	--	14"
No Scan	--	--	--	Horn Lens	$4\frac{1}{4}"$ $5\frac{1}{4}"$ $5\frac{5}{8}"$
1440 RPM	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	Overhead Cone 40°	--	--
--	--	--	--	--	--
--	--	--	--	--	--
1800	--	--	--	--	--

POWER SOURCE				TOTAL SYSTEM WEIGHT	NO. IN USE OR AVAIL. DATE
PHASE OR AMPS	FREQ. (CPS)	KVA	VOLTS		
--	--	--	--	--	--
40A	380-1600 400	1.8 30 VA	28 DC 115, 115	700	7-1-52
1	400-2400	500 W 175 W	115 28 DC	90	12
--	--	--	400 W AC 80 W DC	40	6 on order
Included in Turret Power				150	1 on order June '49
Included in Turret Power				125	1 on order June '49
Included in Turret Power				150	1 on order June '49
Included in Turret Power				125	1 on order
1	380-1760	80W D.C. .4	26.5 DC 115	50	800
4 Amps. D.C.			28 DC	25	45
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	4000	--

INDICATIONS		DISPLAY		SEC. CLAS	REFERENCES
PPI	OTHERS	IFF	BEACON		
--	--	--	--	C	NL - 421019
5"	--	--	--	C	EL - 80
--	--	--	--	R	11 and NL 401011
--	--	no	No	C	EL 80, NL - 401013, #11
--	--	No	No	C	EL - 80, NL - 401015
--	--	No	No	C	EL - 80
--	--	No	No	C	EL - 80
--	--	Yes	Yes	C	NL - 401018 EL - 80
Computing Sight, Reticule and Warning Lights		No	No	R	EL - 80
--	--	--	--	C	NL - 480041
--	--	--	--	C	EL - 80
--	--	--	--	C	R02-04D
--	--	--	--	C	R02-08D
--	--	--	--	C	NE 050517
--	--	--	--	C	NL - 410006
--	--	--	--	C	NL 480042 Code 3667
--	--	--	--	C	R02-26R
--	--	--	--	C	NE 050617

AIRBORNE
SEARCH
AND
WEAPON-
CONTROL
RADARS

REMARKS	MODEL
Provides an AEW beacon system used with AN/APS-20A	AN/APR-12(XN)
For attack and long range bombers. Electronic computer.	AN/APB-3
Circular horn feed with polystyrene lens. Computer AFCS 1,4,6,7,9,11.	AN/APG-18
Supplies range to MK18 and MK23. Computing gun sights.	AN/APG-22
For tail and nose turret installation. Special computer.	AN/APG-25(XN-1)
Tail turret installation. Special computer.	AN/APG-25(XN-2)
Wing tip and nose turret installation. Special computer.	AN/APG-25(XN-3)
Special Computer.	AN/APG-25(XN-4)
AFCS-1, 4, 6, 7, 9, 11 computer.	AN/APG-30
Beam rider system for LARK XSAMN-4 and SKY LARK XSAMN-2. 2 Receivers only, works with AN/SPQ-2.	AN/APW-4
Bombing equipment for carrier based planes.	AN/ASB-1
- - -	--
- - -	--
- - -	--
- - -	--
Spiral beam rider guidance system. Search auto track and dual pulse per quadrant guidance references.	--
Detection of submerged submarines from aircraft.	--
Mod. AN/SPS-2. Rapid scan surface search.	--

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AIRBORNE SEARCH AND WEAPON CONTROL RADARS

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AIRBORNE
SEARCH
AND
WEAPON-
CONTROL
RADARS

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SHIPBOARD WEAPON CONTROL RADARS

TYPE OF GUNS CONTROLLED	FIRE CONTROL SYSTEM OR GUN DIRECTOR USED WITH	FUNCTION
	None	Experimental Anti-Aircraft Automatic Track Fire Control
Main Battery	Mk 34, Mk 38	Surface Main Battery Fire Control
Main Battery	Mk 34, Mk 38	Surface Main Battery Fire Control
5"/38 Cal.	Mk 37	Surface and Anti-Aircraft Fire Control
Main Battery	Mk 34, Mk 38, Mk 54	Surface Main Battery Fire Control
5"/38 Cal.	Radar Mk 12 or G.D. Mk 37	Low Elevation Angle AA Fire Control
5"/38 Cal. 5"/54 Cal.	Mk 37	Surface and AA Auto. Track Fire Control
5"/38 Cal. 5"/54 Cal.	Mk 37	Surface and AA Auto. Track Fire Control
	Mk 37	Missile Guidance and Antiaircraft Auto. Track Fire Control
Main Battery	F.C. Tower, 6" and 8" Turrets	Surface Main Battery Fire Control
5"/38 Cal. 40 mm	GFCS Mk 63	AA Fire Control
40 mm 3" and 5"	GFCS Mk 57 Mods 0, 1 and 2	AA Fire Control
5"/38 Cal. 40 mm	GFCS Mk 63 Mod 6 & 11	AA Fire Control
40 mm, 3"/50, 5"/38 and 6"/47	GFCS Mk 57 Mod 3	AA Fire Control
3"/50, 5"/54, and 6"/47	GFCS Mk 56	Surface and AA Auto. Track Fire Control

SMALLEST SHIP	WEIGHT (LBS)			NUMBER IN USE OR AVAILABLE DATE
	Topside	Lower Deck	Antenna	
	1800	2200 est	1800	2
CL	3209	1229	2750	120
CL	1554	1229	1000	82
DD	1310	1827	460	685
CL	1795	3070	1000	107
DD	713	485	180	876
DD	2000	5000	600	270
DD	2200	5700	600	July 1951
Special	4000	6000		March 1950
CL	1447		425	49
DE	385	1500	135	239
CL	100	1400	70	100 (obsolescent)
DE	115	1700	115	Mod 2 - 278 Mod 6 - 328
CL	185	1600	100	255
CL	598	520	265	165

PEAK POWER (KW)	FREQUENCY RANGE (Mc)	PULSE LENGTH (u sec)	PULSE RATE (pps)
30	3000 9000	0.6	1800
20-30	3050 \pm 50	0.4	1500 \pm 10%
35-45	8815 \pm 75	0.3	1500 \pm 5%
90-110	920-970	1.2	480 \pm 5%
25- 35	8815 \pm 75	0.3	1800 \pm 10%
35	9375 \pm 30	0.5	480
35- 70	8500-9600	0.25	1800 to 2200
250	8500-9600	0.25	1350 \pm 10%
250	9230-9404	0.25	1350 \pm 10% 675 \pm 10%
20- 30	3071-3100	0.4	1500 \pm 10%
30	2992-3019	0.5	1800 \pm 10%
25- 35	9345-9405	0.5	1800 \pm 10%
25- 35	8740-8890	0.3	1800 \pm 10%
25- 35	8740-8890	0.3	1800 \pm 10%
50	8500-9600	0.1	3000 \pm 5%

IF BAND WIDTH (mc)	ACQUISITION SCAN			
	Type	Rate	Horizontal Coverage	Vertical Coverage
6.6	Spiral, PPI, Elliptical	30 cps 2.5 cps	9.1°	9.1°
1.8	Same as Track Scan	10 cps	29°	
5	Same as Track Scan	5 cps	11.5°	
4	Same as Track Scan	60 cps	15°	15°
9	Same as Track Scan	5 cps	11.5°	
5	Same as Track Scan	1 cps	4.5°	+6 -7
9	Spiral Scan	30 cps @ 2 cps	12°	12°
9	Spiral Scan	30 cps @ 2 cps	12°	12°
9	Spiral Scan	30 cps @ 3 cps	6°	6°
4	Same as Track Scan	30 cps	11°	
5	Conical and Antenna Nod	30 cps and .67 cps	11.2°	41.2°
2	Same as Track Scan	30 cps	5°	5°
5	Conical and Antenna Nod	30 cps .67 cps	4.5°	34.5°
5	Same as Track Scan	30 cps	4.5°	4.5°
11	Spiral Scan	24-36 cps @ 2 cps	12°	12°

TRACKING SCAN		REFLECTOR	
Type	Coverage	Type	Size
Conical	2.8°	Paraboloid	57"
Linear Horizontal	29°	Polyrod Array	10'2" H. x 34" V.
Sinusoidal Horizontal	11.5°	Elliptical Paraboloid	8' H. x 2' V.
Lobe Switching	15°	Double Cylindrical Paraboloid	6' x 6'
Sinusoidal Horizontal	11.5°	Elliptical Paraboloid	8' x 2'
Sinusoidal Vertical	13°	Section of Paraboloid	6' x 1½'
Conical	2.6°	Paraboloid	5'
Conical	2.6°	Paraboloid	5'
Conical	2.6°	Lens	7½'
Lobe Switching	11°	Paraboloid	30" H. x 15" V.
Conical	11.2°	Paraboloid	45"
Conical	5°	Paraboloid	30"
Conical	4.5°	Paraboloid	30"
Conical	4.5°	Paraboloid	30"
Conical	3°	Paraboloid	48"

BEAM WIDTH		TRANSMISSION LINE	
Hor.	Vert.	Type	Number
1.6°	1.6°	Wave Guide	
2°	6°	Wave Guide	
0.9°	3.6°	Wave Guide	RG-51/U
10°	10°	Coax Cable	
0.9°	3.6°	Wave Guide	RG-51/U
4.5°	1.2°	Wave Guide	RG-52/U
1.6°	1.6°	Wave Guide	RG-51/U
1.6°	1.6°	Wave Guide	RG-51/U
1°	1°	Wave Guide	RG-51/U
6°	12°	Wave Guide	
6.7°	6.7°	Coax Cable	RG-14/U
3°	3°	Wave Guide	RG-52/U
3°	3°	Wave Guide	RG-51/U
3°	3°	Wave Guide	RG-51/U
2°	2.1°	Wave Guide	RG-52/U

POWER REQUIREMENTS				RANGE (INSTR) MAX (Miles)	RANGE MIN (Yds)
Volts	Phase	Frequency (cps)	KVA		
480	3	60	15	25	250
115 440	1 3	60 60	2.2 2.5	30	250
440 440	3 1	60 60	0.9 2.4	30	200
115	1	60	3.1	25	400
115 440	1 3	60 60	3 0.9	40	350
440 115	3 1	60 60	2 0.28	15	250
115 115	1 3	60	2.54 0.20	25	350
115 115	1 3	60	3.5 0.20	50	350
115 440	1 3	60	6 1	50 200	350
440	1	60	2	30	400
115	1	60	1.7	20	400
115	1	60	1.4	20	350
115 440	1 3	60 60	1.5 0.025	20	350
115 440	1 3	60 60	1.5 0.025	20	350
115 440	1 3	60		15	350

TYPE OF PRESENTATION	RELIABLE TRACKING RANGE	
	Surface DD (yds)	Aircraft F6F (yds)
PPI, DI, A, B, E, C		36000
5" B, 3" B	35000	
5" B, 3" B	40000	
4-3" A or F		45000
6 - 3" B	40000	
2 - 3" E		30000
5" B, 3" A 5" E or Δ E		30000
5" B, 3" A 5" E or Δ E		45000
5" B, 3" A 5" E or Δ E		70000
5" A	30000	
5"A, 2"F, 3"EE		20000
2-2" F, 2" A, 5" A		20000
5"A, 2"F, 3"EE		20000
5" A, 2" A, 2-2" F		20000
5" A/R, 5" B, 7" E		30000

TRACKING ACCURACY			BEARING	
Range (yds)	Bearing (mils)	Elevation (mils)	Track Rate (deg/sec)	Slew (Max) (deg/sec)
$\pm 15 \pm .1\% R$	0.3	0.3	50	50°/sec
$\pm 15 \pm .1\% R$	± 2			
$\pm 15 \pm .1\% R$	± 3.62 , Reset ± 1.5			
$\pm 20 \pm .025\% R$	$\pm 10'$, Reset $\pm 4'$	$\pm 10'$ above 10°	16	25°/sec
$\pm 15 \pm .1\% R$	± 3.62 , Reset ± 1.5			
	.5°	± 3	16	25°/sec
$\pm 15 \pm .1\% R$	± 1 average	± 1 above 1°	16	25°/sec
$\pm 12 \pm .025\% R$	± 1 average	± 1 above 1°	16	25°/sec
$\pm 10 \pm .025\% R$	± 0.7 average	± 0.7	16	25°/sec
$\pm 15 \pm .1\% R$	± 4 , ± 50 PPI			
$\pm 15 \pm .1\% R$	± 2 reset	2 reset	Manual	
$\pm 15 \pm .1\% R$	± 2 reset	2 reset	Manual	
$\pm 15 \pm .1\% R$	± 2 reset	± 2 reset	Manual	
$\pm 15 \pm .1\% R$	± 2 reset	± 2 reset	Manual	
$20 \pm .025\% R$	0.7	0.7 above 1.0°		72°/sec

RESOLUTION		RANGE TRACK RATE (Yds/Sec)	REFERENCES	SECURITY CLASSIFI- CATION
Range (yds)	Bearing			
60	1.4°			R
120	1.0°		9	R
100	0.5°		1, 9	R
300	5.0°	500	1	R
100	15 mils		1, 9	R
90	2.25°		1, 9	R
80	1.30°	500	1, 9, R12-08T	C
80	1.3°	1000		C
80	1.0°	2000		C
150	6.0°		1, 9, 12	U
150	6.0°	± 350 K ± 843.75 K	1, 9, 12	U
100	3.0°	± 250 , - 450	1, 9	U
200	3.0°	843.75 K	1, 9, 12	R
200	3.0°	± 250 , - 450		R
35	1.5°	450	1, 9, 12	C

SHIPBOARD
WEAPON
CONTROL
RADARS

REMARKS	MODEL
Experimental Automatic Tracking Radar	Mk 7 Mk 7 Mod 1
	Mk 8 Mod 2
Mk 8 Mod 2 converted from S-band to X-band	Mk 8 Mod 3
A and F Spot Error Indicator Scopes	Mk 12 Mod 1
	Mk 13
Used with R.E. Mk 12 to provide accurate elevation data below 10°	Mk 22 Mod 1
Used with Computer Mk 1 in GFCS Mk 37	Mk 25 Mod 2
Used with Gun Fire Control System Mk 67	Mk 25 Mod 3
Special purpose missile guidance radar for Terrier; beacon facilities; dual transmitters and dual receiver channels; guidance by frequency modulation of repetition rate	Mk 25 Mod 6
6"/47 and 8"/55 M.B. Turret Radar; also, in BB fire control tower	Mk 27 Mod 0,2
Used with GFCS Mk 63; antenna reflector mounted on gun	Mk 28, Mod 2
Interim radar for GFCS Mk 57. Currently being replaced by R.E. Mk 39 Mod 3	Mk 29 Mod 2
Mod 2 controls 40mm guns; Mod 6 - 3"/50 guns	Mk 34 Mod 2,6
Mk 13 and 14 have acquisition features the same as R.E. Mk 39 Mod 2. Mods determined by type of guns controlled.	Mk 34 Mod 3,4,7-14
	Mk 35 Mod 2

SHIPBOARD WEAPON CONTROL RADARS

TYPE OF GUNS CONTROLLED	FIRE CONTROL SYSTEM OR GUN DIRECTOR USED WITH	FUNCTION
40 mm, 3", 5", and 6"	GFCS Mk 57 Mod 4	AA Fire Control
Torpedo	FCS Mk 101	Experimental Submarine Fire Control
40mm, 6"/47, 5"/38, 54	GFCS Mk 61	Auto Angle Track AA Fire Control
5"/54, 3"/50, 3"/70	Gunar Mk 1	AA Auto Track Fire Control
A.A. G.M.	None	Missile Guidance and AA Automatic Tracking Fire Control
		Passive Homing
		Missile Guidance
		Missile Guidance
	Lark and Skylark	Auto Missile Tracking
	Lark and Skylark	Missile Guidance
		Missile Guidance
None	None	Missile Guidance
		Missile Guidance
Kingfisher E		Missile Guidance and Track

SMALLEST SHIP	WEIGHT (LBS)			NUMBER IN USE OR AVAILABLE DATE
	Topside	Lower Deck	Antenna	
CL	160	1700	110	187
SS	1520 total		550	1(experimental)
DD	220	2129	220	Mod 0 - 4 Mod 1 - 7
DD	132	4000	132	2 Models - Jan 1951, 14 - 1952
DD	11000	6000	5000	Exp. 1952
	75			Sep. 1949
AV-11	7800	2000	2200	1 Jan 1950
	64000 with power including vans			1 in use 2 Dec 1949
	2300 Incl Mount	50000 incl 2 vans	100	1
	6000 lbs total			

PEAK POWER (KW)	FREQUENCY RANGE (Mc)	PULSE LENGTH (μ sec)	PULSE RATE (pps)
25-35	9000-9160	0.5	1800 \pm 10%
50	15800-16200	0.2 0.8	3200-3950 or 900-1100
25-35	9000-9160	0.5	1800 \pm 10%
250	8500-9600	0.25	1320 \pm 10%
3 Meg	5650 \pm 250	0.3 and 3.0	800 and 500
	2700-2950		
	2750-2950		
5	2700-3600		
700	2700-2900	1.0	350-850 576
700	2700-2900	1.0	350-850 576
50	8500-9600	0.25	1000-3500
700	2800	1.0	
35-70	8500-9600	0.25	1800-2200

IF BAND WIDTH(mc)	ACQUISITION SCAN			
	Type	Rate	Horizontal Coverage	Vertical Coverage
3.5	Elliptical Scan	30 cps	5°	19°
	Sector Scan	30 cps	12°	
3.5 to 5.0	Elliptical	30.5 cps to 27.5 cps	3.5°	12°
9	Spiral	30 cps @ 2 cps	12°	12°
5, .5	Raster	4/sec 1/sec	5° x 5° 11° x 11°	5° x 5° 11° x 11°
2.5				
2.2		24 cps		
2.2		24 cps		
11				
2.2			CSC ² 9	
9	Spiral	30 cps	11°	11°

TRACKING SCAN		REFLECTOR	
Type	Coverage	Type	Size
Conical	5.0°	Paraboloid	30"
Lobe Switching	2.2°	Section of Paraboloid	40" H x 8" V
Conical	3.5°	Paraboloid	48"
Conical	3.6°	Paraboloid	40"
Simultaneous Lobing	1.6°	Lens	8' x 8'
		Paraboloid	7- $\frac{1}{2}$ "
Conical	2.0°	Paraboloid	8'
Conical	2.0°	Paraboloid	8'
		SV-4	
Monopulse	System	Lens	72" dia.
Conical	$\pm\frac{1}{2}$ ° squint	Paraboloid	5'

BEAM WIDTH		TRANSMISSION LINE	
Hor.	Vertical	Type	Number
3.0°	3.0°	Wave Guide	RG-52/U
1.5°	9.0°	Wave Guide	
2.0°	2.0°	Wave Guide	RG-52/U RG-51/U
2.2°	2.2°	Wave Guide	RG-51/U
1.6°	1.6°	Wave Guide	
12.0°	12.0°	Coax	
3.0°	3.0°	Wave Guide	
3.0°	3.0°	Wave Guide	
1.4°	1.4°	None	
1.6°	1.6°	Wave Guide	RG-51/U

POWER REQUIREMENTS				RANGE (INSTR) MAX. (Miles)	RANGE MIN (Yds)
Volts	Phase	Frequency (cps)	KVA		
115	1	60	2.2	15	300
120 27.5 V DC	1	400	2.58 400 watts	30	200
115, 440 270 V DC	1, 3 resp.	60	2.75, 0.5, 0.11 KW	15	300
117, 440	1, 3	60, 60	4, .2	20	350
440, 110, 27 V & 110 V	3, 3 DC	60, 400	5, 1, 1 & 1.5	150	500
28 V DC			600 W	200	300
28 V DC 115 V	1	400-1600	3		
110	3	60	7	200	300
110	3	60	7	50	300
115	3	60	Approx. 3 KVA	25	100
				50	300
115, 115 440	1, 3, 3	6	2.54, .18, .20	25	350

TYPE OF PRESENTATION	RELIABLE TRACKING RANGE	
	Surface DD (yds)	Aircraft F6F (yds)
2"E, 2-2"F, 5"A/R, 3"E or EE		20000
5"B, 5"L, 5" PPI		
5" A/R, 2" F, 5" E or EE, 5" PPI		25000
5"-A/R, 5"-B, 5"-E or 4 E, 2"-F		30000
5" B-3 dim., 5" A, 10"-PPI		200000
Auto Control		26000
R-A B-PPI	Horizon	100000
R-A B-PPI	Horizon	100000
IRBEL, Spot		30000 Est
R-A, B, E, B-B, E, E-E, AE	30000	30000

TRACKING ACCURACY			BEARING	
RANGE (Yds)	BEARING (Mils)	ELEVATION (Mils)	TRACK RATE (Deg/Sec)	SLEW (MAX) (Deg/Sec)
$\pm 30 \pm .5\%$ R	± 2 reset	± 2 reset	Manual	
$\pm (3 \pm .1\%$ R)	± 1.1		50	150°/sec
$\pm 30 \pm .5\%$ R	± 2 (Telescope Mk 92 - reset)	± 2 (Telescope Mk 92 - reset)	42	42°/sec
$\pm 10 \pm .025\%$ R	$\pm .75$ mil reset	$\pm .75$ mil reset	30°/sec	30°/sec
$\pm 15 \pm .025\%$ R	$\pm .2$ mil	Tracking $\pm .2$ mil	50°/sec	100°/sec
Must approach target	within 50 feet of	Boresight .25		
± 15	1° at 10°/sec	.1° at 10°/sec	30	36°/sec
± 15	1° at 10°/sec	.1° at 10°/sec	30	36°/sec
$\pm 15 \pm .1\%$	0.2 mils	0.2 mils	50	50°/sec
$\pm 15 \pm .1\%$	± 1 mil Average	± 1 mil Average	16	25°/sec

RESOLUTION		RANGE TRACK RATE (Yds/Sec)	REFERENCES	SECURITY CLASSIFI- CATION
Range (yds)	Bearing			
100	3.0°	+450 -750	1, 9, 12, R12-03T	R
	1.5°	250	NO 304601	S
100	2.0°	+450, -750	1, NO 284603	C
80	2.2°	±1115		C
50	1.3°	2000	NO 314603, Re4f	S
			Code 3609	S
			NL 421001	U
			NE 081104	C
150	2.5°	2500	NE 081403, 4 R05-36D, and #12	C
150	2.5°	2500	Code 3609	U
			NE 081402	R
80	1.4°	1500	NO 284609	C
			# 12	R
80	1.3°	500	NO 314605	C

REMARKS	MODEL
Mod 0, 1 and 2 not installed. One Mod 4 on USS MISSISSIPPI	Mk 39 Mod 3,4
5" PPI, 5" B or L	Mk 44
Automatic tracking in bearing and elevation - Aided tracking in range	Mk 47 Mod 0,1
Antenna reflector mounted on gun mount; slew, tracking and acceleration rates dependent on gun mount drive characteristics	AN/SPG-48
Double RF head for look-thorough. Beacon tracking	AN/SPG-49
Semi-passive homing SKYLARK; AN/SPG-2 used as illuminating source	AN/DPN-7
Transponder type pulse beacon	AN/APN-4(XN)
For GM and P/A tracking	AN/APN-62
Modified SP to include stabilization. Maximum ranges to employ beacons in missiles	AN/SPQ-2
Two receivers. Now AN/MPQ-5	SP-1M LARK
Permits tracking of KUV-1 Missile (LOON). For submarine installation	SV-1
Simultaneous lobing. Angle information is obtained from each individual pulse. May be used as gun director and missile guidance.	RE Mk 50
For use with AN/MPS-4(XN)	SP-1Ma
Modified F.C. Radar Mk 25 Mod 2. Has AFC for beacon signal and provides for command transmission via P.R.F.	

LANDBASED WEAPON CONTROL

PEAK POWER OUTPUT (KW)	FREQUENCY RANGE (MC)	PULSE LENGTH (μ sec)	PULSE RATE (pps)	FUNCTION
200	3000	.2 or .8	1100	F.C. for 90 MM AA guns.
	2927			Fire Control
.015	680-720 920-970	0.75	1639	F.C. Beacon
.300	9310	0.5	1000- 3000	F.C. Beacon
100	1200	1.6	255	Searchlight Control
				Guidance radar
210	2700-2900	0.8	1707	Control and Guidance
				FC for 40 MM AA guns.

Band- WIDTH (mc)	BEARING RESOLN.	RANGE RESOLN.	TYPE OF PRESENTATION	BEAM WIDTH	
				HOR.	VERT.
3.5, 5.1.0		25 yds	5"A, 7"PPI 3"J, 2-2" PN*	5°	5°
				90°	60°
7				120° at 10 th power pt.	80° @ 10 th power pt.
	1 mil	300 yds	1 A 1 pip notch		
				10°	10°
2					
				4°	4°

PN* Pip Notch

RANGE		RELIABLE RANGE		TRACK SCAN	
MAX (miles)	MIN. (yds)	SURFACE (yds)	AIRCRAFT (yds)	HOR.	VERT.
	500		80,000 s 45000 AT	360°	10°
25	300	50,000	50,000		
	500			Helical	

AT- Automatic Track.

TRACKING ACCURACY			ACQUISITION SCAN COVERAGE		WEIGHT (lbs)
RANGE (yds)	BEARING	ELEVATION	HOR.	VERT.	
20	1.5mils	1.5mils			
					40
					100 approx
300	1 mil	1 mil	360°	90°	
			360°		

ACQUISITION SCAN		REFLECTOR		TYPE OF GUNS CONTROLLED	NO. IN USE OR AVAIL. DATE
TYPE	RATE	TYPE	SIZE		
Conical	6 RPM	Circular Paraboloid	67"	90 MM	20
		Corner Reflect- -or dipole		5"/38 to 16"/50	10
		Two feed horns		5"/38 to 16"/50	Nov.49
Conical		Circular Parabolic dish	76"	Search- light	
				40 MM	

POWER SOURCE				REFERENCES
VOLTS	PHASES	FREQ.	KVA	
115	3	60	15	1
105-125		60		1
6 volt batteries 5 amperes.				6 and 12
Gas engine 110		400 cycle		NO 274603,4 NE 081102,R05-10D
115	1	400	3.5	1 and 9
				NO 284609 Code 3609
115	3	60	12	3 and 15
				NE 060801

LANDBASED
WEAPON
CONTROL

REMARKS	SEC. CLASS.	MODEL
	C	AN/MSG -1
Velocity measurements from 400 to 500 ft/sec. AN/TPS-13A is mod. for indoor installation.	C	AN/TPS -13,13A
To direct naval fire during amphibious operations. 10 db antenna gain.	R	MK-2 Mod 0,1,2
For shore bombardment operations. One horn for receiving and one for transmitting.	C	AN/UPN-54 AN/UPN-8
5" A and two 3" pip match presentation.	R	MK-20 Mod 0,1,3
Simultaneous Lobe Comparison(BuO). May be used as Gun Director or Missile Guidance.	C	MK-50
To search, detect, and track. Mod. for control G/M Hermes A-1 or guide Bumblebee.	C	SCR-584
To replace optical aiming.	C	---

PRESENTATION	SEC. CLASS.	FUNCTION
	U	Repeater Indicator
	U	Repeater Indicator
2 - 12" scopes	R	Indicator assembly
10" flat-face P.P.I.	C	Repeater
	U	Bearing and Range Indicator
7" remote P.P.I.	U	P.P.I.
12" modification	U	Repeater
7" horizontal face remote PPI.	U	Repeater
7" vertical P.P.I.	U	Remote P.P.I.
12" P.P.I., Special selective switch.	U	Remote P.P.I.
2-5" P.P.I. Expanded B scope.	R	Precision P.P.I. Repeater
Projects on to 24" horizontal plotting unit. Deck mounted	C	Projection Repeater
5" lightweight remote P.P.I.	R	Repeater
12" P.P.I. Added delay unit	R	Repeater
12" delayed off-centered P.P.I.	C	Repeater
12" delayed off-centered P.P.I.	C	Repeater
12" delayed presentation from 0-180 miles.	C	Repeater Remote R.H.I.
12" P.P.I.	C	Repeater
20" off-centered.	C	Repeater

INPUT DATA	PULSE RATE (PPS)
	150 to 3000
Search radar video and trigger, Antenna bearing, Ships heading, Director train and range from 1 director.	
Standard video, trigger and 1 speed radar bearing. No transmission features.	
Radar information at 1 speed. No range or bearing transmission.	
Standard inputs - 1 speed	60 to 1100
	60 to 1100
	60 to 1100
Standard video, trigger, and 1 speed radar bearing. No range of bearing transmission.	
Standard inputs.	
Range height information from SX or modified SP radar.	
Standard inputs plus I.F.F. or M.T.I. information.	

OUTPUT DATA	RANGE (miles)
	1-5, 4-20, 10-50, 40-200.
Target bearing(1 x synchro)	
Target range(synchro-72000 yds/rev.	
Target range and bearing.	7,5,20,75,200; 4,20,80,200
Target range and bearing.	4,20,80,200.
	4,20,80,200.
	4,20,80,200.
	4,10,20,80,200.
	2,4,10,20,80,200.
	2,4,10,20,80,200.
True bearing transmission at 1 speed & range transmission at 72000 yds / rev.	4,10,20,40,80,200
from 5G's.	4,10,20,40,80,200
	20,40,80,200
	4-20, 15-90, 60-240.
	4-40, 10-100, 20-200.

SWEEP STEP DOWN ?	Elevation SCAN	MAXIMUM HEIGHT (ft)	NUMBER IN USE OR AVAILABLE DATE.	REFERENCES
			1400	6
				6
				6
				6 & 2 NE 051109
				R07 - 32T
			1280 445	1
			225 2571	1
			850 130	1
			66	1
			1250	1 NE 051126
			739, 100, 107	1
			100	1 NE 051127
			600	1 NE 051125
			150	1, R07-17T NE 051102
NO				
YES	-2 to 88°	100,000		6 & 2 NE 051101
			2	6 & 2 NE 051104
			3	6 NE 051105

POWER SOURCE				SIZE H. W. D. (inches)	TOTAL SYSTEM WEIGHT (lbs)
PHASE	FREQ.	K. V. A.	VOLTS		
	400 - 2400		110-120		25
1	60		115	38 x 18 x 19 ³ / ₄	
		12 W .24 KW	6 115		
1	60	.275	115	40x24x20	400
1	60	.175	115	36x16x20	330
1	60	.220	115	30x14x28	180
1	60		115	30x14x34	
1	60	1.3 Operate 0.5 Stand-by	115	43x32x24	1410
1	60	1.765 1.5	115	35x32x59 38x42x89	1280 2650
1	60	0.45	115	20 x 8 x 10	437
1	60	.660	115	32x20x21-1/2	815
1	60	1.84 1.69	115	37-1/2x18-5/16 x16-5/8.	450
1	60	800 Watts	115	17x19x32 12x20x24	400
1	60		115	19x32x17	400
1	60		115		
1	60	1 KW approximate	115	34x30x25.5	300 PS 400

INDICATORS

REMARKS	MODEL
	AN/APA #1A
	AN/APA -32
Ground stabilization and plotting system.	AN/APA -53
Continuously variable range from 200 to 1 mile.	AN/SPA -4
Provides remote PPI and TDT in director. Slave to TDT MK 11 or VJ. PD panel combination.	MK - 3 Mod 2
Selector switch permits selection of any one of 5 radars.	VC VC - 1
Splash proof. May be used on open bridge. Portable. VD-1 has 10 mile range.	VD to VD-2
	VE VE-1
Similar to VE-1 except uses 12" CRT instead of 7".	VE-1A
Surface plotting may be done directly on plotting surfaces. Mod. VF for 400 cycles. VF-1, VF-1A cancelled.	VF
10 or 20 mile sector of overall range may be expanded to fill entire scope. VG-2 has DRT in place of chart table.	VG to VG-3
East-West, North-South off-centering. Will work with AEW or DRA. VH-A is mod. VH for 400 cycles.	VH
Mod. VK. Independent instantaneous ranging strobe, electronic cursor. VJ-A is mod. VJ for 400 cycles.	VJ VJa
Deck mounted. Has provision for manual off-centering, and will accept tracking ing. from DRA or AEW.	VK
Mechanically redesigned VK. Will work with AEW. Off-centering, 40 miles on 4 to 80 mile scale	VK-2
Height indicator. 5 to 1 vertical expansion.	VL
Uses 2 different color PPI displays optically superimposed. IFF or RKI.	VM
Similar to VK. Off-centering to 200 miles. 2 video channels for use with MK-5 IFF. Rubber range scales.	VN

INDICATORS

PRESENTATION	SEC. CLASS.	FUNCTION
	C	Video Insertion Repeater
5 ft. PPI screen.	C	Photographic Repeater
	C	Virtual PPI Reflectoscope
	R	Repeater
	C	Repeater
RCA Graphechon tube. Bright TRACE TUBE.	C	Projection Repeater
	C	3 coordinate Indicator
	C	Dual PPI Repeater
	C	Indicator
	C	Integrated Display
	C	3 coordinate Repeater
	C	Combat Control Center Indicator
	C	Indicator
	C	Indicator
	C	DRT and Automatic plotter.

INPUT DATA	PULSE RATE (PPS)
Standard video, trigger, and 1 speed radar bearing.	
	60. to 1000

OUTPUT DATA	RANGE (miles)
	16,000 yds
	4,10,20,80,200

SWEEP STEP DOWN ?	ELEVATION SCAN	MAXIMUM HEIGHT (ft)	NUMBER IN USE OR AVAILABLE DATE.	REFERENCES
				NE 051108
			4	6, R07-34T NE 051103
				R07-24D NE 051124
				6
				NE 051123
				NE 051122
				NE 051115
				NE 051116
				Ne 051120
				NE051121
				NE051207
				NE 091401
				NL413005
				NO 274605
				NS 693001

	INDICATORS
REMARKS	MODEL
Introduction of printed or written information into video channels. Never produced- closed.	VO
Permits continuous presentation on a 5 ft vertical screen at a distance of 7 ft within 6 seconds.	VP
Used with AN/SPA-4 as navigational aid.	VPR
EXPerimental VH.	X-VH
Increases range of VF to 100 miles	VF-2
To convert low intensity scan to bright PPI raster scan by graphechon techniques. VG indicator.	VG-1A
Used with hemispherical scan radars.	---
To increase quantity of presented data. Plan to use 2-gun CRT to permit simultaneous display without time sharing.	---
To evaluate 3 dimensional information.	---
---	---
Breadboard delivered by RCA to NRL 3930	---
Used by Marines in amphibious landings.	---
Video mapping and projected PPI.	---
To provide transfer of radar target information to the acquiring radar in fire control systems.	---
---	---

TARGET DESIGNATION

RANGE ACCURACY	BEARING ACCURACY	FREQUENCY (Mc)	FUNCTION
			Bearing and Range Converter
			Target Designation
\pm 200 yds Self only	\pm 1° in all coordinates Self only	680 - 720 920 - 970	Bearing, Range and Elevation Parallax Converter
\pm 160 yds overall	\pm 2.3° overall		Target Designation Transmitter
			Bearing Transmitter
			Target Designation Transmitter
			Target Designation
			Bearing and Range Indicator

POWER SUPPLY				REFERENCES	SEC. CLASS.
Volts	Phases	Freq. (cps)	KVA		
110	1	60	--	NO 274107	R
--	--	--	--	NO 274117	C
117	1	60	0.25	NO 274120 12	S
electronic 115	1	60	.506	NO 274105 R07-32T	R
synchro 115	1	60	1.391		
--	--	--	--	NO 274106	S
--	--	--	--	NO 274116	S
--	--	--	--	NO 304203 Re4b	S
6 115			12 W .24 KW	R07-32T	C

INPUT DATA
1. Target Bearing (1 x synchro) 2. Target Range (72000 and 1,296,000 yds/rev) 3. Target Elevation (2 x synchro) 4. Own Ships Course 5. Coordinates of Reference Ship Bearing (1xSynchro), Range(72000 yds/rev)
1. Search Radar Video and Trigger 2. Antenna Bearing (1 X Synchro) 3. Ships Heading (1 X Synchro) 4. Director Train from Four Directors (1 X Synchro)
Search Radar, Video and Trigger Antenna Bearing Ships Heading Director Train and Range from One Director

OUTPUT DATA

1. Target Bearing (1 X Synchro)
2. Target Range (72,000 and 1,296,000 yds/rev)
3. Target Elevation (2 X Synchro)

1. Search Radar, Video and Trigger
 2. Antenna Bearing (1 X Synchro)
 3. Ships Heading (1 X Synchro)
 4. Target Bearing (1 X Synchro)
 5. Target Range (synchro - 72000 yds/rev
- To any or all of six
director stations

Target Bearing (1 X Synchro)
Target Range (synchro - 72000 yds/rev)
Target Elevation (2 X Synchro)

Target Bearing (1 X synchro)
Target Range (synchro - 72000 yds/rev)

To one station

REMARKS	MODEL
Main battery, for use in shore bombardment. Used on CI and above. F.C. computer only. To be replaced by plotter Mk 10.	Mk 1 Mod 0
High speed T.D.S. - Breadboard 3-coordinate T.D. display. Elevation is indicated in color. Converts PPI and IFF display to roster scan.	Mk 2
Converts information referred to one ship to the same elements referred to another ship. Breadboard model only. (1) Should be redesigned before production.	Mk 3 Mod 0
Remote PPI indicator. Incorporates six switching positions to select proper director. (12 in use.)	Mk 11 Mod 1
Target information for torpedo and gun. Optical - Bearing only. Receives automatic track data. For DD, DDE, and DDK.	Mk 14
Optical scope tied to synchros which transmit range and estimated bearing to Air Defense positions (sky forward and aft). Developmental only.	Mk 15
Aided tracking unit for use on VF PPI. (one experimental unit only).	--
Provides remote PPI and T.D.T. in director. Slave to T.D.T. Mk 11 or VJ. P.D. panel combination.	Mk 3 Mod 2

ALTIMETERS

RANGE	ANTENNA PATTERN	FREQUENCY (MC)	POWER OUTPUT	WEIGHT (LBS)
0 - 400 400-4000ft	100° x 60°	420 - 460	0.1W	35
0-10000ft	100° x 60°	1625 - 1675	1.5W	50
0-10,000ft	80° x 60°	4270 - 4330	1.0W	35
0-10,000ft	100° x 60°	1605 - 1655	1.5W	35

POWER SOURCE			ANTENNA	REFERENCE
VOLTS	FREQUENCY	K.V.A.		
28 dc		3 Amps.	Dipole or Slotted	6
28 dc		200 W	Flush mounted	6
28 dc		160 W	Flush mounted	6
115	320 - 1760	130 W	Flush mounted	NL 450035

ALTIMETERS

REMARKS	MODEL
F.M. 115,000 procured. U	AN/APN w 1
F.M. U	AN/APN w22(XN-1)
F.M. U	AN/APN -22(XN-2)
Redesigned AN/APN-22(XN-1) to reduce size, weight, and power requirements. F.M. U	AN/APN -22(XN-3)

TRAINERS

MANEUVERING SIMULATOR					
Target		Own Ship		Max Vert Speed (ft/min)	Function
Turn Rate (deg/sec)	Speed (knots)	Turn Rate (deg/sec)	Speed (knots)		
					Loran Trainer
Manual	0-20	9	80-400	2000	L.A.B. Trainer
					Airborne Search Ultrasonic
					Annapolis Tactical Trainer
			1500		Tactical Trainer
This is primarily a UHF signal generator					Rad CM Trainer
	0-500				Radar Trainer
					AA Gunnery Trainer
0-35	0-2000				Radar Trainer
	V2 speeds				AA Target Simulator
					Radar Trainer
					Radar Trainer
24			1700		Air Search Trainer
24			1700		Radar Trainer

SIGNAL SIMULATOR

Rep Rate (cps)	Pulse Length (μ sec)	Band Width (deg)	Types	Output
			A. Target B. Sea return C. Altitude line E. Noise D. Range attenuation I. LFF F. Fading G. Jamming H. Land	A. 30-60 MC I.F. B. Video C. Trigger D. IX Sync. Ant.
			MASS	
60 to 2000	4, 1, $\frac{1}{2}$			A, B, D
20 to 3000	1 to 10	Var	Radar Transmitter	2700-3100 MC
Same as Radar			A, E, F, G	B
2000	.1	1.6 to 2	A, B, D, E, F, G	A, 60 MC
60 or 200	4 or 1			A
60/200 150/600 300/400				A, D

SPACE SIMULATOR		SERVICE EQUIPMENT	
Problem Area (sq miles)	Number of Targets	Outputs Required	Radar
		A. Trigger B. 1X Synchro Azimuth C. Voltages prop to Azimuth & EL D. L.O. tuning voltage E. 1X 360° Potentiometer Ant AZ	
			AN/APS-2 AN/APQ-5 AN/APS-31
			AN/APS-2,3,4,13,15
36 or 360			SG, SR
36 or 360	6		SG, SV, SR, SS SP-1
			Radar Countermeasures Equipment
50,000 yd radius			Mk 12 in Mk 37
1 min run			Mk 28, 29, 34
50,000 yd radius			Mk 25 or 35
			Mk 65
60 or 200			Mk 3, 4
	6		
		E, B	SA, SC, SK, SR
			SA, SC, SK, SR

Size L.W.H.	Weight (lbs)	POWER SOURCE			
		Volts	Phase	Freq	K.V.A.
		220 110	3 1	60 60	1.915 1.120
		115	1	60	
25"x17"x 44" • 18"x 18"x21"	175 40	115 24	1 DG	400-1500	.850 .075
20'x14'	4753	115	1	60	3 KW
6½' H 2' W	1200 with Mk 51 Director	115	1	60	
		115	1	60	10
	1537	110	1	60	1.155 KW
		110	1	60	

Number of Operators That are Trained	Security Class.	Number of Equipments Produced	Available Date
	U		
	U		
	U		
	R	1	
	R		
Unlimited	R	1	Under Evaluation
	R		
Complete Crew (3)	R	11	
1	U	200	1 Jan 1950
Crew for Mk 25 or 35	C	7	Estimated July 1950
	C		
	U		
	R		
	R	30	
	R		

TRAINERS

REMARKS	REFERENCE	MODEL
	6	AN/APN-T4
	6	AN/APQ-5-T1A
	6	AN/APS-T1-T3
To train CIC personnel (Annapolis). Optical projector.	6	AN/SSQ-T1
For CIC personnel. DRT will be from indicators.	NE 051314	AN/SSQ-T2(XW-1)
	NR 825002	AN/UIT-T1
Known as "Modified Rug.", also RRL-F-3800	6	AN/UPT-T4
Permanent information by tape recording meters.	1	Mk 2
For GFCS Mk 57 or 63	NO 284306 R13-03T	Mk 8
Three independent moving targets. (3 coordinates). All problems recorded on film.	NO 284606	Mk 10
	NO 284617	
	6	OAC
For use in CIC schools. Obsolescent. See OCJ and CCZ.	6 12	OCJ
Uses 6 cams for bearing, range, and intensity. To be replaced by OCJ-1.	6 12	OCJ
Mod OCJ. Target course cams cannot be changed after program has started.	NE 051323	OCJ-1

TRAINERS

MANEUVERING SIMULATOR					
Target		Own Ship		Max Vert Speed (ft/min)	Function
Turn Rate (deg/sec)	Speed (knots)	Turn Rate (deg/sec)	Speed (knots)		
24			1700	5000 dive 40000	Radar Trainer
24			1700		Radar Trainer
Land mass		6	75-300	None	Optical PPI Trainer
Manual	100-600 5-30	Manual	100-600	Manual	Cadillac Evaluation System
Manual	4-24	Manual	100-600	None	M.A.D. Trainer
Manual	100-600 5-30	Fixed	Station	None	Search Radar Trainer
Manual	100-600 5-30	Manual	100-600 5-30	None	Primary PPI Plotting Trainer
Slaved to device	21-A-7				Submarine Attack Teacher
27	50-450			5000	AN/APS-6 Night Fighter Trainer
27	100-900			10000	Night Fighter Trainer
		None	None		GCA Trainer
Manual	100-600	Manual	100-600	1000	Airborne Search Radar Trainer
					Target Simulator
					Radar Trainer
					Tactical Trainer

SIGNAL SIMULATOR				
Rep Rate (cps)	Pulse Length (μ sec)	Beam Width (deg)	Types	Output
			A. Target I.IFF E. Noise B. Sea Return F. Fading C. Altitude Line G. Jamming D. Range Atten. H. Land Masses	A. 30-60 Mc IF B. Video C. Trigger D. IX Sync Ant
60 or 200	4 or 1			
60/200 150/600 300/400				A, D
Ext.		Var	A, D, F, I	B
MAD Comparator used	with recorder			
200 & Slave	2	Var	A, D, F, I	B
Sequence scan			A	
Slaved to SS Radar				
Same as	AN/APS-19		A, B, C, D, E, I	A
Same as	AN/APQ-35		A, B, C, D, E, I	A
Same as	AN/MPN-1		A, D, E, F	A
200			A, B, C, D, H	B, C

SPACE SIMULATOR		SERVICE EQUIPMENT	
Problem Area (sq miles)	Number of Targets	Outputs Required	Radar
		A. Trigger B. 1X Synchro Azimuth C. Voltages Prop to Azimuth & EL D. L.O. Tuning Voltage E. 1X 360° Potentiometer Ant AZ	
			SA, SC, SK, SR
			SA, SC, SK, SR
400 X 400		A, C, D	AN/APQ-35
200 X 200	30	A, B	AN/APS-20 AN/APA-56, 57
25	1		
200 X 200	6	A, B	All Air Search PPI's
100 X 100 or 2500			
2500	5	A, E	SS
200 X 200		A, C, D	AN/APS-19
400 X 400		A, C, D	AN/APQ-35
100 X 100		A, C	AN/MPN-1
400 X 600 Land Mass		B	AN/APS-20, 31, 33
	24		
			SX
36 or 360			

Size L.W.H.	Weight (lbs)	POWER SOURCE			
		Volts	Phases	Freq.	K.V.A.
	1645	110-130	1	58-60	
	1645	110-130	1	58-60	
2x2x5	70	115	1	60	375
Consists of 5 15J1c units		105-125	1	60	
4x4x4 Estimated	500	115	1	60	1
24"x24"x 24" (3 units)	550	105-125	1	60	1.3
17"x20"x 48". 16"x 22"x36"	460	105-125	1	60	2
	960				
16"x19"x 48"		115	1	60	2
20'x1'x7'	6650	230 115	3 1	60 60	20 2.5
		Plus regular AN/APS-19 required			
Will be mounted in trailer		Not determined - approx same as 15V4			
12'x4'x7'	3500	230	3	60	5
8'x4'x5'					
		90-125	1	60	

Number of Operators that are Trained	Security Class.	of Equipments Produced	Available Date
	R		
	R		
20	R	40	In Stock
Cadillac Crew	C	Under Development	Contemplate 11/49
1	C	1	Devel. 12-49
Unlimited	C	16	October 49
6	C	4	All Allocated
	C		
2	C	6	In Stock
3	C	Under Development	Prototype
4	C	1	In Use Olathe, Kansas
1	C	Under Development	Prototype 8/49
	C		
	C		
	C		

TRAINERS

REMARKS	REFERENCE	MODEL
Incorporates analog computer. To be replaced by OCZ-1.	6	OCZ
Target course speed and altitude can be changed at the will of instructor.	NE 051324	OCZ-1
Classroom optical PPI trainer.		15AE2
Airborne CIC	NR 784006	15AM1
Permits complete tactical submarine search.	NR 825008	15G2
	NR 821003	15J1C
Displayed on large C.R.T.	NR 821004	15J2B
	NR 821006	15M8
		15V4
	NR 821002	15V5
OCA operations trainer.		15W1
	NR 821001	15Z3
	NE 051322	
To provide 24 echos. Height finder.	NE 051313	
Gunfire and torpedo tracks shown at 2000 ft/sec at range of 2000 to 16000 yds.	NE 051317	

APPENDIX A
Electronic Equipment Subject Classification

I. Radar

- A. Altimeters
- B. Indicators
- C. Search Radar
 - 1. Shipboard
 - 2. Airborne
 - 3. Landbased
- D. Target Designation
- E. Trainers
- F. Weapon Control
 - 1. Shipboard
 - 2. Airborne
 - 3. Landbased

II. Communication

- A. Voice and Code
 - 1. Radio
 - a. Receivers
 - b. Transmitters
 - c. Transmitter Receiver Sets
 - 2. Wire
 - a. Intercommunication Systems
 - b. Announcing Systems
 - c. Telephone Systems
 - d. Telegraph Sets
 - 3. Infrared
 - a. Receivers
 - b. Transmitters
- B. Terminal Equipments
 - 1. Telepicture
 - 2. Teletype
 - a. Frequency Shift Keyers
 - b. Frequency Shift Converters
 - c. Printers
 - d. Miscellaneous Accessories
 - 3. Speech Security
 - 4. Television
 - a. Receivers
 - b. Transmitters
- C. Miscellaneous
 - 1. Ships Consoles
 - 2. Signal Lamps
 - 3. Telautograph
 - 4. Antennas

III. Data Transmission

- A. Continuous
- B. Digital

IV. Countermeasures

- A. Intercept and Analysis
 - 1. Direction Finders
 - 2. Indicators
 - 3. Receivers
 - 4. Recorders
 - 5. Trainers
- B. Deception
 - 1. Active
 - 2. Passive
- C. Jammers
 - 1. Transmitters
 - 2. Search and Jam Systems
 - 3. Trainers

V. Navigation

- A. Direction Finders
- B. Buoys
- C. Homing Systems
- D. Landing Systems
- E. Long Range Navigation

VI. Radio Control

- A. Aircraft
 - 1. Automatic Pilot
 - 2. Bombsight
 - 3. Remote Control
- B. Guided Missiles
 - 1. Proximity Fuses
 - 2. Remote Control
 - 3. Target Seeking
- C. Remote Operations

VII. Identification and Recognition

VIII. Sound

- A. Echo Ranging and Listening
 - 1. Sonar
 - 2. Listening Devices
 - 3. Fathometer
 - 4. Sound Location
- B. Recording Devices
- C. Sono Buoys
- D. Training Devices

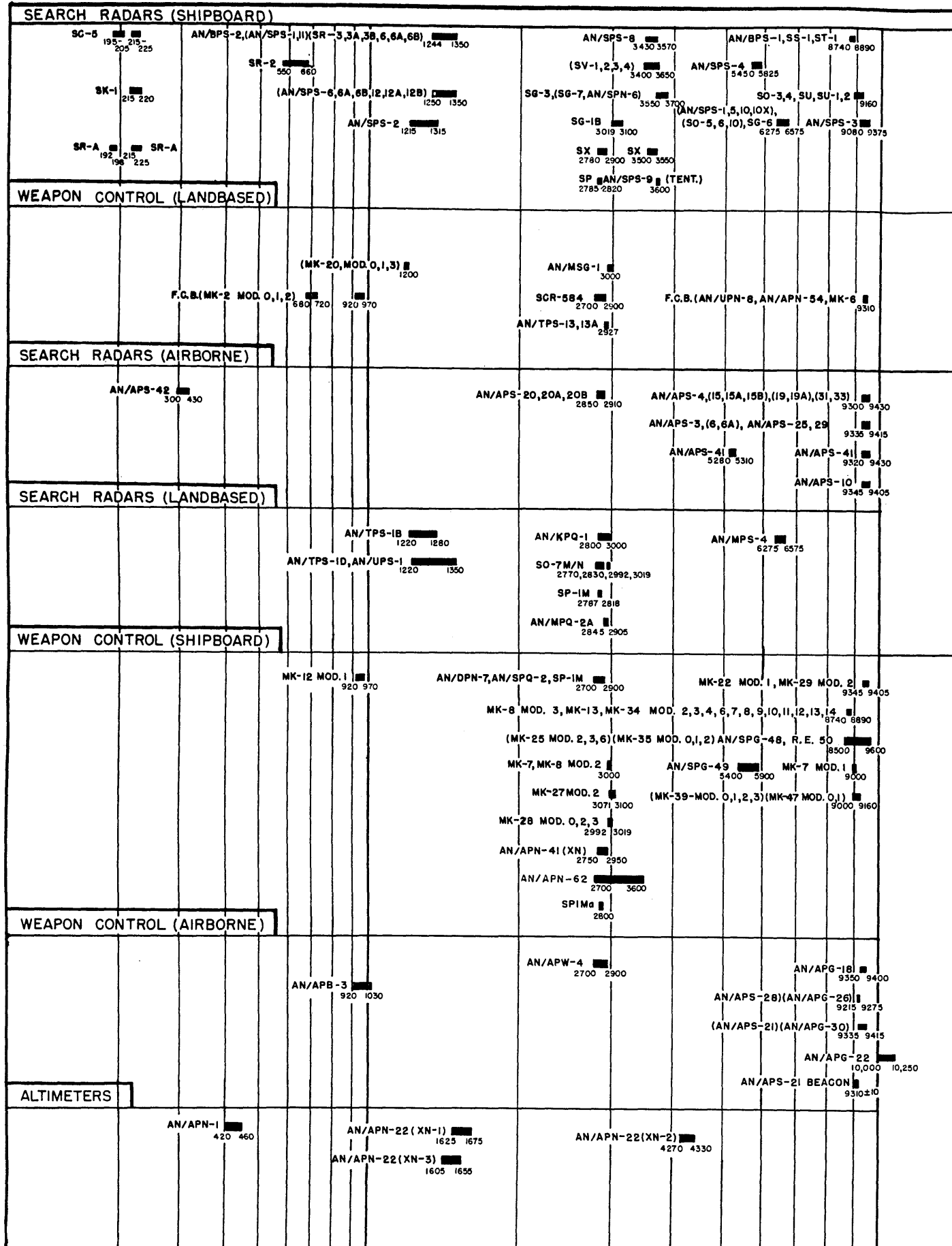
- IX. Radiac
 - A. Computers
 - B. Detectors
 - 1. Fixed
 - 2. Portable Survey
 - 3. Dosimeters
 - C. Trainers
- X. Infrared Detection
- XI. Magnetic Detection
- XII. Computation
 - A. Analog
 - B. Digital
 - C. Stable Elements
- XIII. Measurement and Test

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APPENDIX B
List of Publications and Sources of Information

1. Catalogue of Electronic Equipment, April 1946, BuShips NavShips 900,116.
(Confidential)
2. Chart of Surface Search Radars prepared by BuShips Code 820, March 1949.
3. Catalog of Marine Corps Electronic Equipment, Oct. 1948, TA Descriptive Section.
4. Catalogue of Test Equipment, August 1945, NavShips 900,105.
5. Electronic Equipment Type Allowance Booklet, April 1948, RE 11A 100.
6. List of Naval Electronic Equipment, NavShips 900,123, (formerly Ships 242-A) Jan. 1947. (Confidential)
7. Manual of Test Equipment of Airborne Electrical and Electronic Equipment NavAer 08-5s-78, Jan. 1948. (Confidential)
8. Reference on this number has been deleted.
9. "Electron" Fire Control Radars, BuShips Feb. 1947 NavShips 900,100.
(Confidential)
10. Division 14 of the National Defense Research Committee. N.D.R.C. Final Project Report, Dec. 1945.
11. U. S. Radar Survey Section 1 Airborne Radar, Change 1, N.D.R.C. August 1945.
(Confidential)
12. U. S. Radar Survey Section 2, Shipborne Radar, N.D.R.C. August 1945.
(Confidential)
13. U. S. Radar Survey Section 4, Navigational Radar, Change 1. N.D.R.C. June 1945. (Confidential)
14. U. S. Radar Survey Section 7, Nomenclature Index, N.D.R.C. Dec. 1944.
(Confidential)
15. U. S. Radar Survey Section 3, Ground Radar, Change 1, N.D.R.C. May 1945.
(Confidential)

NOTE: In addition there are a number of NRL Problem Assignments and RDB Project Cards as noted specifically in the tables.



	CXJG ■ 23744 24244							
		AN/SPS-7,9 ■ 34550 35050						
MK-44 ■ 15800 16200								